



Montana Department of Transportation

2701 Prospect Avenue
PO Box 201001
Helena, MT 59620-1001
www.mdt.mt.gov

Stage 2 - Research Topic Statement

Print Form

RESEARCH PROGRAMS USE ONLY

RESEARCH IDEA NO:	21-016
DATE OF RECEIPT:	Apr 30, 2020
TOTAL MDT COST W/ICAP:	

RESEARCH PROGRAMS

Please submit completed forms via e-mail to MDTResearch@mt.gov. All fields are required, except the last field: XVIII, Sponsor(s). Incomplete forms will not be accepted.

TITLE (required): Feasibility of Non-Proprietary Ultra-High Performance Concrete (UHPC) for Use in Highway Bridges in Montana: Implementation

TOPIC STATEMENT:

Ultra-high performance concrete (UHPC) has mechanical and durability properties that far exceed those of conventional concrete. However, using UHPC in conventional concrete applications has been cost prohibitive, with commercially available/proprietary mixes costing approximately 30 times more than conventional concrete. Previous research conducted at Montana State University (MSU) has focused on the development and evaluation of non-proprietary UHPC mixes made with materials readily available in Montana. These mixes are significantly less expensive than commercially available UHPC mixes, thus opening the door for their use in construction projects in the state. The focus of the proposed project is on taking this material beyond the laboratory, and successfully using it on a bridge project in Montana, specifically for field cast joints. This project is a required step to fully understand and capitalize on the benefits of using UHPC for this application and increase the performance, durability, and efficiency of Montana bridges.

RELATED RESEARCH SUMMARY FROM STAGE 1:

Previous research conducted at MSU has included 1) the development of nonproprietary UHPC mixes that are significantly less expensive than commercially available mixes and are made with materials readily available in Montana, 2) an investigation into several items related to the field batching of these mixes, 3) an exploration into the potential variability in performance related to differences in constituent materials, and 4) the investigation of rebar bond strength and the subsequent effect this has on development length. This previous research has been successful and has clearly demonstrated the feasibility of using UHPC in Montana bridge projects. Specifically, this research demonstrated that its use in field cast joints between adjacent precast deck panels could be particularly useful. In this application, UHPC can reduce congestion and the requisite spacing between the panels, and ultimately improve the overall performance of the bridge. However, this research also demonstrated the need for experience with this material in order to ensure its successful application.

RESEARCH PROPOSED:

The focus of the proposed research is on the implementation of this newly developed non-proprietary UHPC in closure pours on an actual bridge project in Montana. The scope of this project would include: (1) closing any minor research gaps that may prohibit UHPC use in the desired application – e.g., testing epoxy coated rebar in bar pullout tests, (2) the development of specifications for this material documenting mix proportions and batching/mixing instructions (3) working with MDT to identify a potential bridge project that would be suitable for UHPC closure pours, (4) working with the selected contractor to conduct and test several trial batches/pours to ensure proper mixing/curing/finishing procedures, (5) assisting contractor on bridge project and preparing specimens for quality control tests, and (6) monitoring the performance of the deck after completion.

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RESEARCH PERIOD (Time to complete research project.):

2 Years

IT COMPONENT: Identify if the project includes an IT component (purchasing of IT hardware, development of databases, acquisition of existing applications, etc.). If so, describe IT component in as much detail as possible.

The work proposed herein does not require IT hardware, software or support.

FEASIBILITY, PROBABILITY OF SUCCESS, AND RISK:

The proposed research has a high likelihood for success and is low risk.

URGENCY, IMPORTANCE, AND EXPECTED BENEFITS/PAY-OFF: Address urgency, timeliness, and importance of the research. Identify if the research is required for any federal or state initiative or compliance. This section must include a description of how this research will help to meet MDT's mission (i.e., serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality and/or sensitivity to the environment).

Aging infrastructure and limited budgets require robust and proven bridge construction, rehabilitation and replacement strategies that are cost-effective and efficient. The non-proprietary fiber-reinforced UHPC mixes developed in the Phase I/II research are significantly less expensive than proprietary mixes, costing \$1000 per cubic yard, compared to \$2500-3500 per cubic yard from commercial suppliers. Upon completion of this project, Montana can take advantage of the cost savings of this non-proprietary UHPC and ultimately improve the performance and durability of its bridges.

IMPLEMENTABILITY, IMPLEMENTATION PLAN, AND RESPONSIBILITY: Address the implementability of the expected results from the proposed project. Identify products that will enhance implementation. Identify any known implementation barriers and how these barriers might be eliminated or reduced. Identify MDT office or entity outside of MDT responsible for implementation. Describe initial implementation plan, include timeframe for implementation.

The focus of this project is on the implementation of a concrete developed as part of earlier research. This project will assist in developing material specifications for UHPC in Montana, will document any potential difficulties in its use, and demonstrate the benefits of using this material in this application for future bridge projects.

MDT PRIORITY FOCUS AREAS: MDT may, as often as annually, identify priority research focus areas. These focus areas will be listed on <http://www.mdt.mt.gov/research/unique/solicit.shtml>.

None

TOTAL COST ESTIMATE (If the project proposal comes in at a higher cost, it may require further approval and may be delayed.):

The preliminary cost estimate is \$100,000.

MDT FUNDING SOURCE (If MDT Research, enter SPR): SPR

FUNDING MATCH SOURCE AND AMOUNT: None

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FUNDING PARTNER(S): None

POTENTIAL TECHNICAL PANEL MEMBERS (At this time, individuals do not necessarily need to be identified; rather, MDT offices and outside entities can be named. However, if known, individuals may be named):

Stephanie Brandenberger, Nathan Haddick, Lenci Kappes, Paul Bushnell, Matt Needham

SUBMITTED BY: (required)	
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CHAMPION: Must be internal to MDT, feel strongly that the research will benefit the Department, and is willing to chair the technical panel. Note: If a champion is not identified by you or Research staff, this topic statement will not move forward.

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SPONSOR(S) (optional): Must be internal to MDT (Division Administrator or higher) and willing to ensure implementation occurs, as appropriate. If a sponsor is not identified by you or Research staff, this topic statement will not move forward.

NAME:	Dwane Kailey
TITLE:	
AFFILIATION:	
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